

NEED TO KNOW

a national security newsletter

Volume 3, Number 3

April 2003

INEEL and Bechtel Telecom Collaborate on Wireless Testbed

Cell towers are sprouting up all over the American landscape like beanstalks in a well-tended garden, seeded by the enormous increase in cell phone use. A March 2002 study

reported a 29 percent growth rate for cell phone ownership over the previous two years, with 62 percent of American adults owning a cell phone.

Cell phone use is no longer limited to calling home from the road to say you'll be late, or making appointments with prospective customers. Wireless communications and technologies can turn cell phones into futuristic offices, connecting users to the Internet, allowing them to download materials, play games, and even shoot or send snapshots.

These increases in usage and capabilities are not without their growing pains, both for commercial vendors and the public. Problems range from interference and service interruption to troubles with network integration and handset interoperability. The costs and complications of solving some of these problems can be immense. But the INEEL and Bechtel Telecommunications have a suggestion to help overcome these obstacles – test it before you deploy it.

Before offering new handsets, installing thousands of new antennas, or integrating new

technologies, test them in a full-scale environment. While this sounds like the standard step in any engineering design process, it hasn't been done because it couldn't be done. No facility existed where wireless communications could be tested in a life-size, city-like setting. Laboratory or bench-scale tests had to suffice.

Until now.

End-to-End Testing

In collaboration with Bechtel Telecommunications, INEEL has established the Bechtel/INEEL Wireless Testbed. The Testbed

See **TESTBED**, page 2

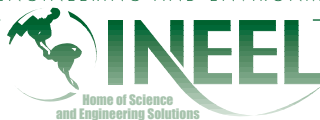
The three cell sites are located across 16 square miles of the INEEL in a life-size, city-like setting.

A technician makes final adjustments to an antenna prior to its installation and testing.

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IDAHO NATIONAL ENGINEERING AND ENVIRONMENTAL LABORATORY



TESTBED *(continued from page 1)*

offers large-scale, independent, end-to-end testing of next-generation, wired and wireless communication infrastructures including 3G/4G cellular, land mobile radios, and wireless local area network systems.

Lynda Brighton, the project engineer for the Testbed, helped define the goals of the program.

Over the past several months, the INEEL/Bechtel team of researchers and engineers has constructed three cell sites on the INEEL site.



“We wanted to create an environment to allow carriers and the manufacturers of next generation equipment to bring it in and test it end-to-end,” said Brighton. “Test, characterize and troubleshoot their equipment free from interference with current systems, free from disrupting current customers, free from competitors’ eyes, and free from bad

press if it doesn’t work the first time out.”

Over the past several months, the INEEL/Bechtel team of researchers and engineers has constructed three cell towers at the Central Facilities Area on the INEEL site and has provisioned them with various radio equipment, test equipment and modeling/simulation tools to the tune of more than \$1 million. And this is on top of the Department of Energy’s 20 years of large communications infrastructure investments at INEEL that have resulted in 170 miles of high-speed fiber, radio labs and shops, and two mountaintop radio transmission facilities.

This agglomeration of equipment and infrastructure has

another feature that further enhances its value as a test range – its location. INEEL’s remote and secure site offers a virtually RF-clean environment – the purity of a true laboratory. And yet researchers can add interference as another controlled variable in a test process. An equally important feature is INEEL’s ability to transmit at all but a few frequencies under its National Telecommunications Information Administration test station status.

The potential customer base for the Wireless Testbed is enormous. It’s so large that Bechtel Telecommunications is concentrating on the commercial side, while the INEEL addresses government. Bechtel is inviting top management from such international wireless giants as Verizon, Nextel, Dutchtone, Cingular, Telecom Italia, and O2 to the Grand Opening and Demonstration planned for the end of summer 2003.

Open for Business

With the Testbed completely operational and open for business April 1, INEEL is already discussing issues such as security and interoperability with government agencies. An unusual aspect of the nation’s communication infrastructure is

The Wireless Testbed offers large-scale, independent, end-to-end testing of wired and wireless next-generation communication infrastructure to commercial and government entities.





Steve Williams, communications systems designer, and Lynda Brighton, Testbed project engineer, led a large and diverse INEEL team in the planning, design and construction of the Wireless Testbed.

that for the most part, communication systems are operated by the commercial sector. Corporations, households, metropolitan areas and even government entities are mixing a variety of wireless and wired systems for universal connectivity across all media types such as voice, data and video. Commercial efforts on mobile data networks have favored ease of use and open access to services that create new vulnerabilities in the wireless and wired infrastructures, and the new portable devices that utilize them. The Testbed can help pinpoint these vulnerabilities and test methods to overcome them.

Brighton talked about the areas for testing, including base station equipment, antennas, handsets or the big hitter for Homeland Security, 911 systems.

"In some neighborhoods, a person might not want to see a lot of cell towers," said Brighton. "We can test distributed systems, which consist of a number of smaller antennas,

maybe attached to existing power poles or light poles, that send information back to a base station located at the normal cell towers. We also plan on testing smart antennas. Typical cellular antennas are omni-directional, meaning the energy is radiated equally in all directions. Smart antennas, which shape and direct their signals, waste less energy, extend range with reduced noise, and provide the capability to deny service in defined directions."

Another area of interest to both commercial entities and government agencies is the wireless local area network or WLANs. New buildings are constructed with network wiring in place, allowing employees to work "connected." But older buildings require lots of modifications to achieve connectivity. These wireless networks offer an excellent alternative, yet come with a different price tag – potential loss of security. INEEL engineers are developing complex

processes incorporating WLANS; coupling their cyber security expertise with the Testbed capabilities creates a dynamic duo for organizations interested in testing these systems.

Antennas and Cell Phones

One of the strengths of the Wireless Testbed that can't be included on any equipment list is its project engineer. Lynda Brighton traveled a circuitous route before becoming the project engineer on the Wireless Testbed.

Brighton is an Idaho Falls native who left the state to study electromagnetics at the University of Utah. There, a lecture from a Hughes Aircraft engineer so intrigued her that upon graduation she went into antenna design for Hughes.

"I very quickly learned that a bachelor's (of science) wasn't enough, at least for me," said Brighton. "I needed to know more about microwave theory."

Fortunately for Brighton, Hughes offered a microwave master's program in cooperation with UCLA. Brighton took advantage of the program and after completion, went from managing an antenna test facility to antenna design.

Brighton's next move was up the California coast to Randtron Antenna Systems where she worked on the E2-C antenna and rotary coupler system, considered by many within the defense industry, the "8th Wonder of the World." But Brighton's experience is not limited to antenna design and testing. She spent some time with Radix Technologies, developing a cell phone location system and an adaptive GPS receiver.

This scope of education and experience appears tailor-made for the Wireless Testbed. The INEEL was quick to recognize this and offered Brighton the position of project engineer and the opportunity to return to Idaho.

"The Wireless Testbed is not the product of one person, one organization, or even one company," said Brighton. "Within just the INEEL, it has taken a great team comprised of National Security management and engineers, IRM (Information Resource Management), Construction Management, and Site Operations to get this up and running. And, of course, we worked with Bechtel Telecommunications who not only brought its expertise, but also funded the construction of the cell sites. It took a team of intelligent, motivated individuals to conceive, design, build and operate this Testbed."

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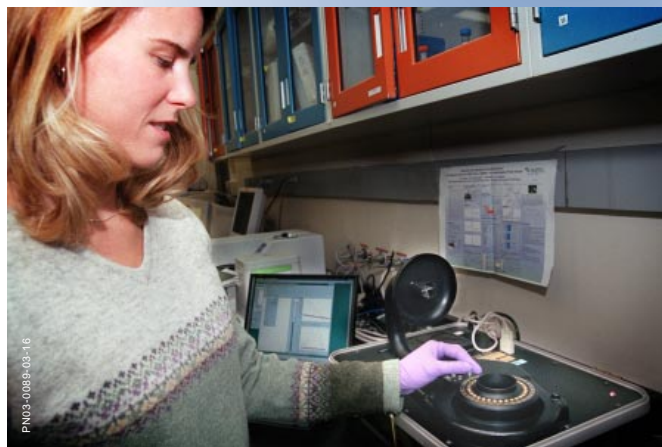


INEEL molecular biologist Deborah Newby loads pipules into a polymerase chain reaction system (left and below). The field-portable, real-time PCR system used by Newby and colleague Frank Roberto is called the R.A.P.I.D. System developed by Idaho Technology Inc.

INEEL Scientists Developing Biological Threat Agent Detection Capability

“Yellowstone sends bison to slaughter; more captured.” The March 2003 newspaper headline blared the story, but to readers in the states surrounding the first national park, the slaughter of bison was nothing new. In the winter of 1996-1997, over 1,600 bison migrating from Yellowstone National Park into Montana in search of food were killed to prevent the possible spread of brucellosis to cattle ranging near the northern boundaries of the park, thus destroying Montana’s brucellosis-free status.

Brucellosis is an infectious bacterial disease caused by the *Brucella* species. It is called a zoonosis because the disease can be transmitted from animals to humans, particularly cattle through contact with reproductive tissues or consumption of infected, unpasteurized milk. In animals such as cattle, bison, elk, sheep and goats – and in some



rare instances, seals – the disease can cause spontaneous abortion and an inability to conceive in females, and epididymitis in males. In humans, the disease is called by a variety of names such as undulant fever, Malta fever or Bang’s disease. According to the Centers for Disease Control and Prevention, symptoms of brucellosis infection in people

include fever, night sweats, undue fatigue, anorexia, headache, and arthralgia or joint pain. It is seldom fatal, but there is no effective human vaccine.

Currently, brucellosis is diagnosed with either a serological test that detects antibodies against *Brucella* or with cultivation. Current serological tests cannot predict whether an animal is actively

infected. Occasionally, seronegative animals have been culture-positive. Blood or tissue cultures – currently the gold standard for diagnosis – come with potential negatives. Since the microorganisms can be spread by aerosol routes, additional biological containment measures must be added to control the risk of infection. And culture testing takes time.

Field Assay System

INEEL molecular biologists Frank Roberto and Deborah Newby are developing a quick, safe, accurate method to detect the brucellosis strain, *B. abortus*, in the field. Roberto and Newby are designing a DNA-based field assay using a field-portable, real-time polymerase chain reaction (PCR) system.

PCR is a technique for copying and amplifying the complementary strands of a target deoxyribonucleic acid molecule. Using a DNA sample and primers (consisting of the four chemical components that make up genetic material), the DNA target can be duplicated millions of times. It is the sequence of the nucleotides that make any species unique, or in humans, every individual unique. The INEEL scientists developed the specific primers that began the copying process for *B. abortus*.

PCR then detects and quantifies DNA targets by measuring an increased fluorescence in each cycle of DNA duplication. Real-time PCR produces results more rapidly than conventional PCR and has the added advantage of allowing probes to increase specificity. Real-time PCR can also differentiate multiplex reactions and is more accurate since it is based on a

dynamic process rather than an endpoint measurement.

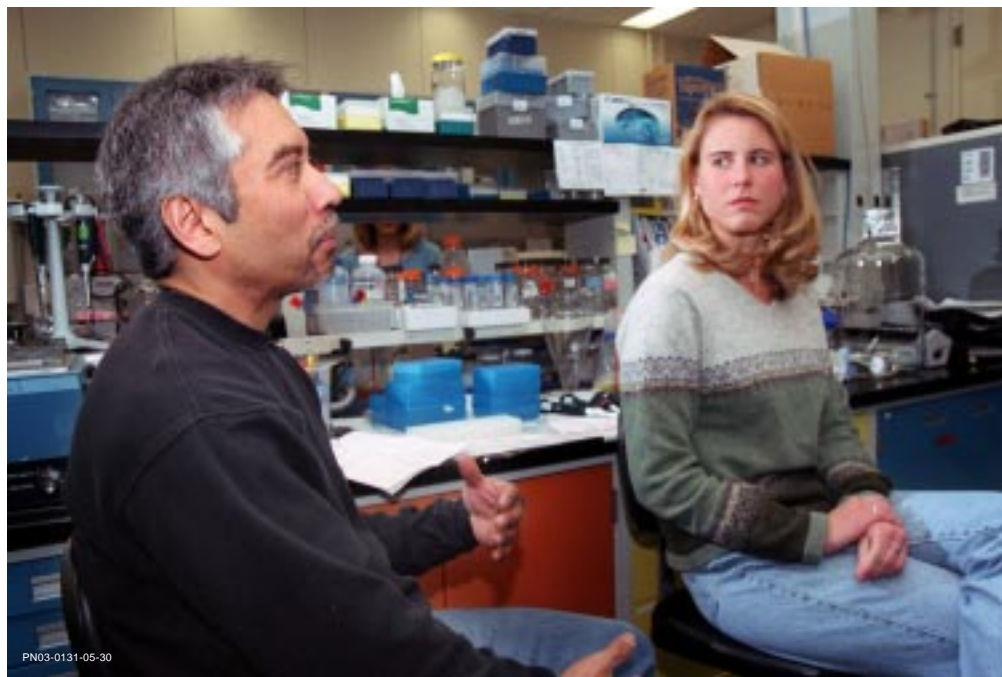
Roberto and Newby optimized and evaluated several probes that monitor fluorescence during the assay process to determine the most accurate method. All three, once optimized, detected seven orders of magnitude of genomic *B. abortus* DNA. But one – the hybridization method – also allowed the specificity required to narrow identification to the *B. abortus* most accurately. The scientists' results have been validated through culture testing.

Bioterrorism threat

"Domestic bioterrorism is a real threat. We saw that with the anthrax scare," said Newby. "But with the exception of *Bacillus anthracis* (anthrax) and *Yersinia pestis* (plague), not much validated work has been done on the detection of other pathogenic threat agents."

A strain of *brucella*, *B. suis*, was the first microorganism developed in the former U.S. biological weapons program, primarily because of the ease with which it can be spread through aerosol routes of infection.

Brucella strains remain a concern from the biological warfare and bioterrorism perspective, even though they were recently reclassified as Category B agents. But the assay identification work done by Newby and Roberto may have other far-ranging implications. Emerging genomic



INEEL molecular biologists Frank Roberto and Deborah Newby are developing a quick, safe, accurate method to detect the brucellosis strain, *B. abortus*, in the field.

information points to a commonality in virulence-related genes among a range of human, animal and plant pathogens, including the deadly plague and brucellosis. In some, such as the plant pathogen *A. tumefaciens*, a vir locus is responsible for recognizing the host by the bacterium, leading to induction of other genes and ultimately, infection.

Brucella strains share extensive sequence similarities with other proteobacteria and recent work has focused on using these parallels to understand the biology of host-pathogen interactions. This type of research increases our

understanding of host range of *Brucella* and may reveal new strategies for combating disease.

Agricultural Concern

"In our area, brucellosis is primarily an agricultural concern," said Roberto. "The current field methods for detecting the disease in bison, cattle or elk are not very accurate. It's comparable to saying you have measles because you have the antibodies. You may have had it as a child and are now immune."

Roberto and Newby can prepare the DNA from cattle, bison or elk blood samples in less than an hour and using PCR, can confirm

active infection of *B. abortus* in another 45 minutes. This method, validated through culture testing, also reduces false-negative and false-positive results.

The United States has spent an estimated \$3.5 billion to eradicate bovine brucellosis, but vaccinations are not completely effective. Worldwide, it is even more of a problem, infecting cattle, sheep, goats and pigs. Regionally, the impact to wildlife garners the headlines.

Newby's and Roberto's research will not only lead to the development of sensitive DNA-based assays supporting national and homeland security missions, it will help address the question of whether brucellosis in wild bison and elk can lead to infection of cattle in the states surrounding Yellowstone, addressing a regional problem for agriculture and wildlife management.

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The field assay will address national homeland security threats and regional agricultural issues.





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INEEL Adds WMD Training To Its Repertoire

The INEEL's Critical Infrastructure Test Range tests more than just systems, equipment and processes. It also tests bodies and minds.

The National Security Division has teamed with the West Desert Test Center, Special Programs Division, at Dugway Proving Ground, Utah, to offer training expertise and optimal training environments to military units, regional law enforcement, and National Guard Weapons of Mass Destruction Civil Support Teams.

It all started with the Hazmat Cam, the wireless video camera designed by National Security engineer Kevin Young. (See Need to Know, Jan. 2003). A project manager of Dugway's nationally recognized chem/bio antiterrorism training and field exercise program, invited Young and colleague Yvette Leppert to demonstrate the camera's capabilities to various WMD CSTs during exercises conducted in Utah. Project managers do not endorse new technologies, but like to offer training teams

the opportunity to use cutting-edge systems in the field and decide for themselves.

The response to Hazmat Cam was excellent, and Young and Leppert attended many sessions, demonstrating the system. But it was during the After Action Reviews that the subject of INEEL training expertise was raised.

Chemical, Biological and Now Radiological

The West Desert Test Center specializes in realistic, challeng-

A military unit participates in WMD training during a field exercise held at the INEEL. The training program is conducted in collaboration with the West Desert Test Center, Special Programs Division, Dugway Proving Ground, Utah.

ing training for threats from chemical and biological weapons of mass destruction. But the CST teams wanted credible radiological training not available at the Utah facility. Leppert and Young thought the INEEL just might be able to help.

The INEEL technical experts have taught comprehensive radiological safety courses to thousands of employees, subcontractors and construction workers. Leppert met with Kevin Hungate from Site Wide Training to discuss tailoring the radiological safety courses for a WMD environment.

"We followed the same principles developing this course that the National Security engineers follow when they design complex integrated systems," said Leppert. "We involved the customer from the very start." INEEL's Young, Leppert and Hungate worked with Dugway's Special Programs Division and a CST member from the Idaho National Guard to develop a model for the training course. Hungate and his staff developed the course materials and Hungate conducted the first radiological training course and field exercise in February at Dugway.

The premiere went off without a hitch. The CSTs in the class were pleased with the content, duration, level of training and accompanying exercise. Hungate continues to conduct the course, both through National Security's sponsorship and his DOE RAP (Radiological Assistance Program) team membership duties.

Realistic and Challenging

In the meantime, a Special Programs Division project manager toured the INEEL with Leppert, investigating training locations and scenarios that would continue to challenge the elite CSTs. They found plenty. The test range's complex infrastructure mirrors the industrial sections of towns and cities across the country. The empty buildings, roads, railroad tracks, and open spaces all presented endless possibilities to the imaginative Utah trainer. He decided to expand the relationship with the Laboratory beyond radiological training, and INEEL held the first Dugway-sponsored exercise on the range soon thereafter.

"The exercises are complex and challenging," said Leppert, who — along with Young — spent a long night supporting the event. "Dugway's motto is 'hard on the training field, easy on the battle field.' The exercise not only tests the team and its processes, it also gives them increased familiarization and confidence in the team's systems and equipment." "The exercises are meant to be tough," said the participating

"We followed the same principles developing this course that the National Security engineers follow when they design complex integrated systems," said INEEL's Yvette Leppert. "We involved the customer from the very start."



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Dugway project manager and trainer. "We came to the INEEL so we could offer a realistic situation in unknown territory. We wanted to get them out of their comfort zone."

Dugway's West Desert Test Center prides itself on real-life scenarios. The exercise conducted deep in the covered roadway at Test Area North was no exception.

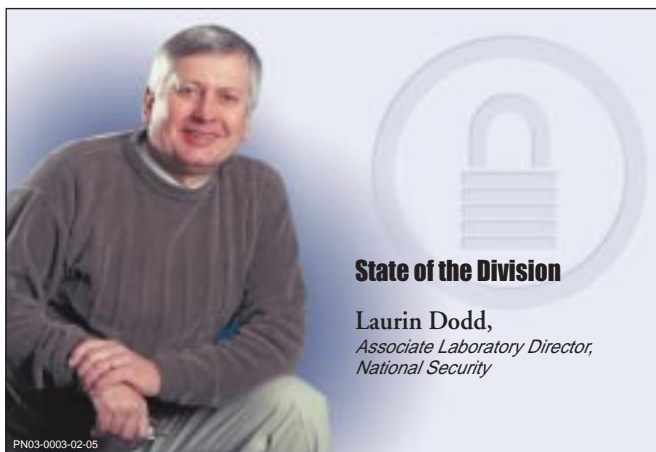
On that cold, clear night in February, 14 members of a military unit participated in a WMD exercise focusing on the threat of chemical weapons. No lights were lit beyond those the team could bring. A frighteningly real chem lab had been created. As the night unfolded, the team progressed through the prescribed stages — first entry, reconnaissance, chemical sampling, evaluation, decontamination, and after-action review.

Gone Shopping

The National Security Division is in the process of taking over some currently inactive buildings at the Power Burst Facility. As part of its overall Critical Infrastructure Assurance Program, the Division is establishing a Control Center and test-and-evaluation environment there. Leppert will use some of the space to create lifelike surroundings for simulating a variety of chemical, biological or radiological WMD incidents. So she went on a shopping spree.

Leppert visited the INEEL's excess equipment warehouse and acquired beds, refrigerators, desks, dysfunctional computers — all of the props needed to create a credible stage for upcoming exercises.

Some of those exercises are already scheduled. National Security is coordinating a multi-agency WMD training exercise in June and others are planned throughout the year.



State of the Division

Laurin Dodd,
Associate Laboratory Director,
National Security

As I write this piece, our Wireless Testbed has been in operation for a little over a week — successfully demonstrating a capability for large-scale research, development and testing of advanced wireless communications systems. This first project is in support of a well-known cellular services provider and the work is being performed jointly with our CRADA partner, Bechtel Telecommunications. During the next several weeks, we will be hosting visitors from several government agencies to explore their needs and priorities for future use of this Testbed. Jane Gibson, Lynda Brighton and their team deserves many kudos for their extraordinary efforts that have made the Wireless Testbed a reality.

Operation Iraqi Freedom is nearly complete. The demonstrated state of U.S. military technologies is astounding. Staff at the INEEL site take considerable

pride in their contributions to some of those technologies. Examples include:

- Abrams M1 tanks are protected with depleted uranium armor manufactured at the INEEL's SMC facility;
- INEEL-developed sensors for characterizing potential weapons of mass destruction are deployed in theater; and
- Combat support systems developed at INEEL are supporting troops in several areas.

Need to Know has won another award, this time from the Idaho Press Club. Congratulations again to Kathy Gatens and the staff that work with her for their innovation and high standards in developing and publishing this newsletter.

Finally, Kathy points out that all of the articles in this quarter's newsletter happen to feature some of INEEL's finest women scientists and engineers.

The mission of the INEEL's Critical Infrastructure Assurance program is to create a national resource where technologies, systems and policies that protect the nation are developed, tested and validated under real-world

conditions. To these elements, the INEEL can now add bodies and minds.

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The Definitions of Terrorism

Contributed by: Gene Johannes

Generally, terrorism falls into two categories; domestic terrorism and state-sponsored terrorism. Domestic terrorists may give numerous explanations for their violence, however, “these rationalizations are frequently related to three basic concepts:

1. Society is sick and cannot be cured by half-measures of reform.
2. The state is in itself violent and can be countered and overcome only by violence.
3. The truth of the terrorist cause justifies any action that supports it. While some terrorists recognize no moral law, others have their own “higher morality.”

State-sponsored terrorism – normally sponsored by states with one-party dictatorships – is used “as part of a campaign of geographic expansion of political control through weakening and destabilizing existing state structures based on political

pluralism and representative government. Striking fear in populations much broader than the victims themselves, extortion and radical political change are the expected results.”

In any situation, terrorism “is

deliberately planned, organized, initiated and launched by people who wish to dramatize the powerlessness of governments. The overriding consideration of all terrorist acts is to humiliate governments and expose their impotence. And this impotence is dramatized with special force and acuity when a handful of people are able to strike at anyone, anywhere, anytime.” Given repeated terrorist attacks, the initial shock and horror is eventually transformed into criticism and anger toward the government for not preventing such attacks. Once the government is shown to be unable to stop the attacks, the people will pressure the government to consider the terrorists’ claims. “This is a no-lose proposition for the terrorist. If the government does not give in, the terrorist promises further terrorism. This induces further criticism of the government and more, increasingly desperate calls to heed the

terrorist demands. If the government succumbs, the terrorist scores an obvious victory...the citizen knows that his government has caved in and betrayed his trust yet again. And once the line of concession is crossed, more atrocities and more demands are sure to follow, with the inexorable logic of blackmail in the face of weakness. The terrorist objective is not negotiation, but capitulation.”

What can we as individuals do to help deter terrorism? At home and abroad - BE AWARE. Be aware of what is going on around you. Be aware of anything that just doesn't look, sound, feel, or seem right. REPORT IT! Report anything that gives you cause to think that something just isn't right. Remember JDLR. If it “Just Doesn't Look Right,” it probably isn't and should be reported.



NEED TO KNOW is a publication of the National Security Division of the Idaho National Engineering and Environmental Laboratory. The INEEL is a science-based, applied engineering national laboratory dedicated to supporting the U.S. Department of Energy's missions in environment, energy, science and national security. The INEEL is operated for the DOE by Bechtel BWXT Idaho, LLC. Requests for additional copies, story ideas or questions should be directed to the editor at (208) 526-1058, kzc@inel.gov. This is printed on recycled paper.

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